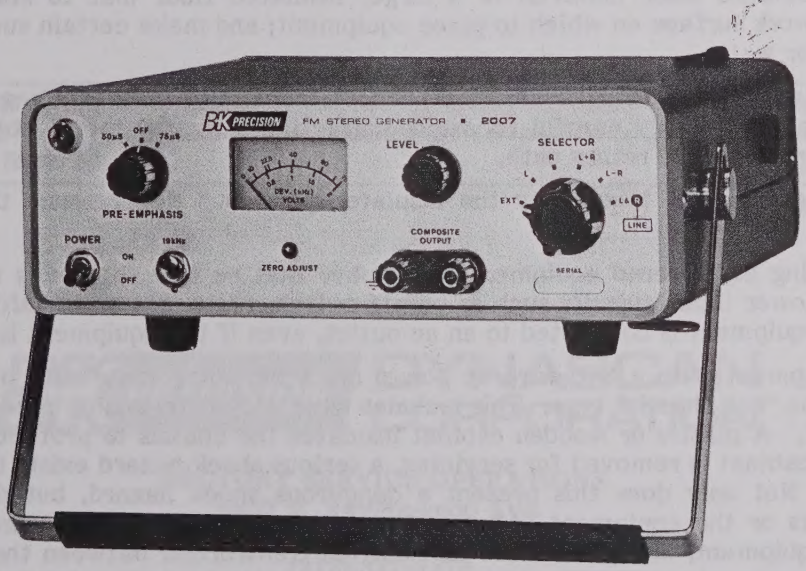
B+K PRECISION DYNASCAN CORPORATION

SERVICE MANUAL

Model 2007

FM STEREO GENERATOR



VIKING LABS / HONEYWELL
370 BERNARDO AVENUE
MOUNTAIN VIEW, CA 94043

B+K PRECISION DYNASCAN CORPORATION

TEST INSTRUMENT SAFETY

WARNING

Normal use of test equipment exposes you to a certain amount of danger from electrical shock because testing must often be performed where exposed high voltage is present. An electrical shock causing 10 milliamps of current to pass through the heart will stop most human heartbeats. Voltage as low as 35 volts dc or ac rms should be considered dangerous and hazardous since it can produce a lethal current under certain conditions. Higher voltages pose an even greater threat because such voltage can more easily produce a lethal current. Your normal work habits should include all accepted practices that will prevent contact with exposed high voltage, and that will steer current away from your heart in case of accidental contact with a high voltage. You will significantly reduce the risk factor if you know and observe the following safety precautions:

1. Don't expose high voltage needlessly. Remove housings and covers only when necessary. Turn off equipment while making test connections in high-voltage circuits. Discharge high-voltage capacitors after removing power.
2. If possible, familiarize yourself with the equipment being tested and the location of its high voltage points. However, remember that high voltage may appear at unexpected points in defective equipment.
3. Use an insulated floor material or a large, insulated floor mat to stand on, and an insulated work surface on which to place equipment; and make certain such surfaces are not damp or wet.
4. Use the time-proven "one hand in the pocket" technique while handling an instrument probe. Be particularly careful to avoid contacting a nearby metal object that could provide a good ground return path.
5. When using a probe, touch only the insulated portion. Never touch the exposed tip portion.
6. When testing ac powered equipment, remember that ac line voltage is usually present on some power input circuits such as on-off switch, fuses, power transformer, etc. any time the equipment is connected to an ac outlet, even if the equipment is turned off.
7. Some equipment with a two-wire ac power cord, including some with polarized power plugs, is the "hot chassis" type. This includes most recent television receivers and audio equipment. A plastic or wooden cabinet insulates the chassis to protect the customer. When the cabinet is removed for servicing, a serious shock hazard exists if the chassis is touched. Not only does this present a dangerous shock hazard, but damage to test instruments or the equipment under test may result. To make measurements in "hot chassis" equipment, always connect an isolation transformer between the ac outlet and the equipment under test. The **B & K-Precision** Model TR-110 or 1604 Isolation Transformer, or Model 1653 or 1655 AC Power Supply is suitable for most applications. To be on the safe side, treat all two-wire ac powered equipment as "hot chassis" unless you are sure it has an isolated chassis or an earth ground chassis.
8. Never work alone. Someone should be nearby to render aid if necessary. Training in CPR (cardio-pulmonary resuscitation) first aid is highly recommended.

SERVICE MANUAL

for

B & K-PRECISION

Model 2007

FM Stereo Generator

This service manual is intended for use by qualified electronics technicians only. To avoid electrical shock, do not perform servicing unless you are qualified to do so.

B+K PRECISION DYNASCAN CORPORATION

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Please use this address for parts orders or technical inquiries

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Model 2007 Operator's Manual 480-432-9-001

Model 2007 Schematic Diagrams and Parts List 499-316-9-001

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https://archive.org/details/manualsplus_06571

SPECIFICATIONS

RF OUTPUT

Carrier Frequency:
83 to 87 MHz or 96 to 100 MHz (2 bands), continuously adjustable.

Output Voltage:
100 mV or more, open circuit.

Output Impedance:
300 Ω balanced.

Antenna Jack:
Use antenna to simulate broadcast signal.

Modulation:
0 to 75 kHz deviation, adjustable; monitored on front panel meter.

Modulation Distortion:
2% or less.

Signal-to-Noise Ratio:
-40 dB or more (for L + R signal at 75 kHz deviation).

MODULATION SIGNALS

L, R, (L + R), or (L - R):
Internal (1 kHz).

(L & R):
L = Internal (1 kHz).
R = Internal (50/60 Hz Line).

External:
Independent L and R input terminals.

EXTERNAL MODULATION

Modulating Frequency:
50 Hz to 15 kHz.

Input Impedance:
100 kΩ or more.

Max. Input Voltage:
2 V rms.

Pre-emphasis:
Selectable 50 μs, 75 μs, or off. Within ±2 dB for both 50 μs and 75 μs.

METERING

Signal Output:
All outputs monitored on front-panel meter (0 to 2 V).

Deviation:
Deviation of r-f output signal monitored on front-panel meter (0 to 75 kHz deviation).

SIGNAL OUTPUTS
(Monitored on front-panel meter)

Frequency Response:
100 Hz to 10 kHz ± 1 dB.
50 Hz to 15 kHz ± 2 dB.

Output Voltage:
0 to 2 Vrms, continuously adjustable.

Output Impedance:
600 Ω.

Distortion:
1% or less.

SUB-CARRIER OUTPUT

Carrier Frequency:
38 kHz ±4 Hz.

Frequency Response:
23 to 53 kHz ±3 dB.

COMPOSITE SIGNAL OUTPUTS
L, R, (L + R), (L - R), (L & R)

Channel Isolation:
40 dB or more, 100 Hz to 10 kHz.
30 dB or more, 50 Hz to 15 kHz.

Stability:
Channel isolation does not fluctuate more than 3 dB in 30 minutes, when measured 30 minutes after switch-on.

Crosstalk Between Channels:
30 dB or more.

38 kHz Leakage:
-40 dB or more at maximum output.

POWER REQUIREMENTS

Source Voltage:
Selectable 100, 117, or 230 volt AC, ±10%.

Line Frequency:
50 or 60 Hz.

Power Consumption:
5 watts.

MECHANICAL SPECIFICATIONS

Dimensions (WxHxD):

Basic Case:
8.25 x 2.75 x 11" (210 x 70 x 280 mm).

Including All Projections:
9 x 3.35 x 12" (230 x 85 x 307 mm).

Weight:
4.4 lbs (2 kg).

ACCESSORIES

Accessories Included:

Three Hook-Up Cables (dual banana plug to alligator clips).

Antenna.

Instruction Manual.

Schematic Diagram/Parts List.

FM STEREO MODULATION SCHEME

INTRODUCTION

The Model 2007 FM Stereo Signal Generator simulates the modulation scheme used by FM stereo broadcast stations. The modulation scheme permits stereo receivers to separate audio into left and right channels, or permits monaural FM receivers to combine left and right channel audio into a single output. Fig. 1 illustrates the composite audio modulating signal used for stereo FM. Fig. 2 and its corresponding text describe how the composite audio signal of Fig. 1 is developed. Fig. 3 and its associated text describe how an rf signal is demodulated into left and right audio channels in an FM stereo receiver.

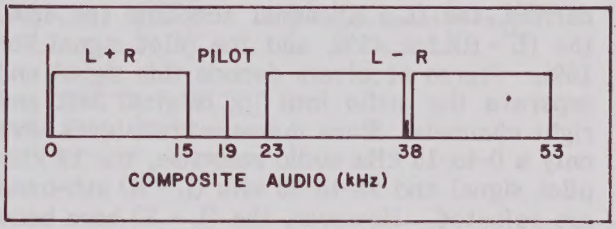


Fig. 1. Makeup of Composite Audio Used for FM Stereo Modulation.

GENERATION OF COMPOSITE AUDIO

Refer to Fig. 2. Left and right channel audio are applied through pre-emphasis networks to a summing network, which adds the two signals. A low pass filter limits this signal to the 0-to-15 kHz audio band, which is the maximum authorized for FM broadcast service. This (L + R) signal contains both left and right channel audio in a 0-to-15 kHz base band.

The left channel audio is applied to another summing network, along with the right channel audio, which has been inverted. The summing network effectively subtracts the two signals. This 0-to-15 kHz (L - R) signal is fed to a balanced modulator, along with a 38 kHz sine wave. The balanced modulator produces a double sideband suppressed carrier (DSBSC) sub-band about 38 kHz. A band pass filter limits this signal to the 23-to-53 kHz range (±15 kHz of the 38 kHz carrier). Thus, the (L - R) signal is a 23-to-53 kHz sub-band with the 38 kHz sub-carrier itself fully suppressed.

For stereo broadcasting, a low level 19 kHz pilot signal is also transmitted continuously. This is generated by a stable, crystal controlled pilot oscillator operating at 19 kHz. The 19 kHz pilot oscillator output is also applied to a frequency doubler, providing the 38 kHz carrier for the balanced modulator.

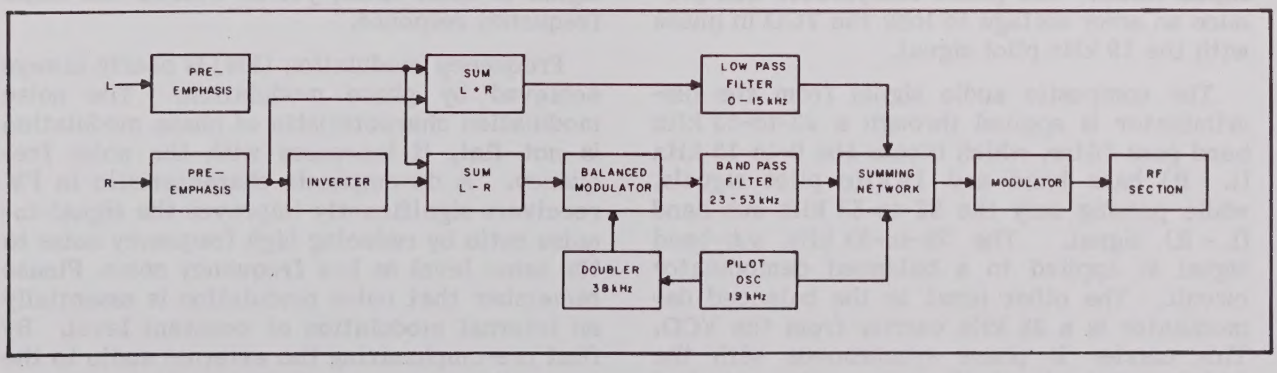


Fig. 2. FM Stereo Modulation Scheme, Transmitter Block Diagram.

The 0-to-15 kHz base band (L + R), 23-to-53 kHz sub-band (L - R), and 19 kHz pilot signal are applied to a summing network, resulting in a composite audio signal consisting of all three components (see Fig. 1). The composite audio signal is applied to the modulator, which FM modulates the rf carrier of the transmitter. For a fully modulated rf carrier, the (L + R) signal accounts for 45%, the (L - R) for 45%, and the pilot signal for 10%. Stereo receivers decode this signal and separate the audio into its original left and right channels. Since monaural receivers have only a 0-to-15 kHz audio response, the 19 kHz pilot signal and 23-to-53 kHz (L - R) sub-band are rejected. However, the (L + R) base band signal is accepted, and it monaurally combines left and right channel audio. Thus, the Model 2007 FM Stereo Signal Generator may be used with monaural FM receivers as well as stereo FM receivers.

FM STEREO DECODING

Refer to Fig. 3. In a stereo FM receiver, the discriminator output is a composite audio signal as shown in Fig. 1. This composite audio signal consists of the 0-to-15 kHz base band, 23-to-53 kHz sub-band, and 19 kHz pilot signal.

A phase locked loop (PLL) locks the sine wave output of the 38 kHz VCO (voltage controlled oscillator) in phase with the received 19 kHz pilot signal as follows. A divide-by-2 circuit converts the 38 kHz VCO output to a 19 kHz sine wave, which is one of the inputs to a phase comparator. The other input to the phase comparator is the received 19 kHz pilot signal itself. The phase comparator will produce an error voltage to lock the VCO in phase with the 19 kHz pilot signal.

The composite audio signal from the discriminator is applied through a 23-to-53 kHz band pass filter, which blocks the 0-to-15 kHz (L + R) base band and 19 kHz pilot signals, while passing only the 23-to-53 kHz sub-band (L - R) signal. The 23-to-53 kHz sub-band signal is applied to a balanced demodulator circuit. The other input to the balanced demodulator is a 38 kHz carrier from the VCO. This carrier is phase synchronous with the 19 kHz pilot signal through a phase locked loop, as previously described. The output of the balanced demodulator is a 0-to-15 kHz (L - R) signal which duplicates the original (L - R) signal of the transmitter.

During monaural reception or loss of signal, a significant error voltage output from the phase comparator results. During stereo reception (presence of 19 kHz pilot signal), the error voltage from the phase comparator approaches zero as phase lock is achieved. The 19 kHz pilot detector acts as a threshold comparator. When the error voltage from the phase comparator drops below threshold of the 19 kHz pilot detector, it lights the stereo indicator on the receiver and turns on the switch to couple the (L - R) signal to the decode matrix.

When (L + R) and (L - R) signals are applied to the inputs of the decode matrix, the matrix separates the L and R components into independent left and right channel outputs. When the (L - R) input is absent, such as during monaural reception, the (L + R) input is not separated into L and R components. Instead, both outputs are identical (L + R) signals.

PRE-EMPHASIS AND DE-EMPHASIS

A pre-emphasis network couples high frequency audio more readily than low frequency audio (emphasizes the highs). Conversely, a de-emphasis network couples high frequency audio less readily than low frequency audio (de-emphasizes the highs). A pre-emphasis characteristic is used in all FM transmitters and a corresponding de-emphasis characteristic is used in all FM receivers for improved signal-to-noise ratio, yet an overall flat audio frequency response.

Frequency modulation (FM) is nearly always achieved by phase modulation. The noise modulation characteristic of phase modulation is not flat, it increases with the noise frequency. A de-emphasis characteristic in FM receivers significantly improves the signal-to-noise ratio by reducing high frequency noise to the same level as low frequency noise. Please remember that noise modulation is essentially an internal modulation of constant level. By first pre-emphasizing the external audio to the transmitter, an overall flat audio response is

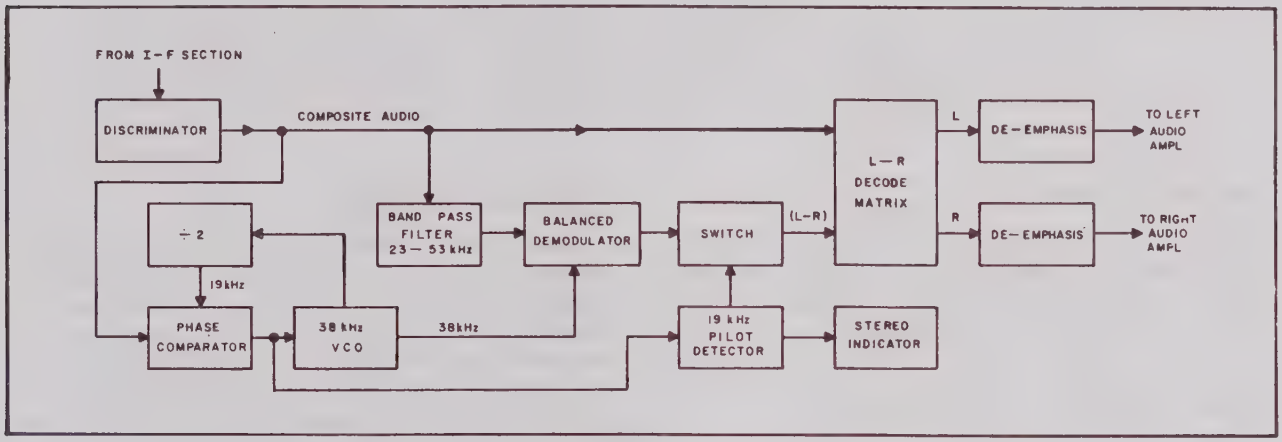


Fig. 3. FM Stereo Demodulation Scheme, Receiver Block Diagram.

possible, because this compensates for the de-emphasis characteristic of the receiver, but does not affect noise modulation.

Refer to Fig. 2. Note that left and right channel audio are each routed through a pre-emphasis network prior to the modulation circuit of a transmitter. Refer to Fig. 3. Note that audio outputs from the decode matrix are routed through a de-emphasis network prior to being sent to audio amplifiers.

The standard low frequency roll-off rate of a pre-emphasis network is 6 dB per octave, which corresponds to the standard 6 dB per octave high frequency roll-off rate of a de-emphasis network. The RC time constant of the coupling components in a pre-emphasis or de-emphasis network determine the center frequency, and are specified in microseconds; 75 μs is standard in U.S.A., 50 μs is standard in some countries. The Model 2007 FM Stereo Signal Generator is universal by offering a choice of 75 μs or 50 μs. An off position permits testing the effectiveness and roll-off rate of de-emphasis networks by comparing levels with flat and pre-emphasized signals applied.

CIRCUIT ANALYSIS

INTRODUCTION

For circuit analysis at a block diagram level, refer to accompanying block diagram, Fig. 4. For a more detailed circuit analysis, refer to the schematic diagram.

SUB-CARRIER AND PILOT SIGNAL GENERATION

304 kHz Oscillator

Transistor Q1 and its associated components form a Pierce oscillator configuration, which operates at 304 kHz. Crystal control assures frequency accuracy and stability. This circuit generates the fundamental signal from which the 38 kHz sub-carrier and 19 kHz pilot signal are created.

1/8 Divider

The 304 kHz signal is frequency divided by eight to become 38 kHz by transistors Q2 and Q5 as follows. Transistor Q2 oscillates at approximately 38 kHz in a Colpitts configuration. The oscillator frequency is variable by means of coil L2. The 304 kHz signal is injected into this stage through the emitter to force the stage into synchronization and produce an accurate 38 kHz signal. The 38 kHz output of Q2 is developed at the emitter, and coupled through buffer Q5, an emitter follower, for isolation.

1/2 Divider

The 38 kHz signal is frequency divided by two to become 19 kHz by transistor Q3. Similarly to the 1/8 frequency divider, this second divider oscillates at approximately 19 kHz. The 38 kHz signal from Q5 is injected at the emitter of Q3 to force the stage into synchronization and produce an accurate 19 kHz pilot signal. The 19 kHz output is also developed at the emitter.

Sub-Carrier Amplifier

The 38 kHz signal from Q5 is amplified and shaped to a good sine wave by sub-carrier amplifier, transistor Q6 and transformer T7. The amplified output of Q6 is developed across transformer, L7, which is tuned for resonance at 38 kHz. This improves the sine wave characteristic and suppresses any remnants of the 304 kHz signal. The center-tapped secondary provides a two-phase 38 kHz sub-carrier; i.e., two out-of-phase sine waves at 38 kHz.

Pilot Signal Amplifier

Similar to the sub-carrier amplifier, the pilot signal amplifier boosts and shapes the 19 kHz pilot signal to a good sine wave. The circuit includes transistors Q7, Q9, and Q10. The 19 kHz output of 1/2 divider, Q3, is amplified by Q7 and developed across transformer, L8, which is tuned for resonance at 19 kHz. This improves the sine wave characteristic and produces two out-of-phase 19 kHz signals, which are applied across the phase shift network consisting of capacitor C31 and 19 kHz PHASE control VR101. Since VR101 is variable, the output phase is variable. The pilot signal is then routed to buffer Q9 through 19 kHz LEVEL control VR102, which adjusts the amplitude, and switch S103 which permits the pilot signal to be turned on or off as needed. Transistor Q9 is an emitter follower circuit, isolating the output from the phase shift circuit. Transistor Q10 is an amplifier which provides the pilot signal output. The pilot signal is mixed with the composite audio signal in the output circuit, Q19.

EXTERNAL MODULATION

Pre-Emphasis Network

A pre-emphasis coupling network is located in the external modulation input for both left and right channels. A front panel switch per-

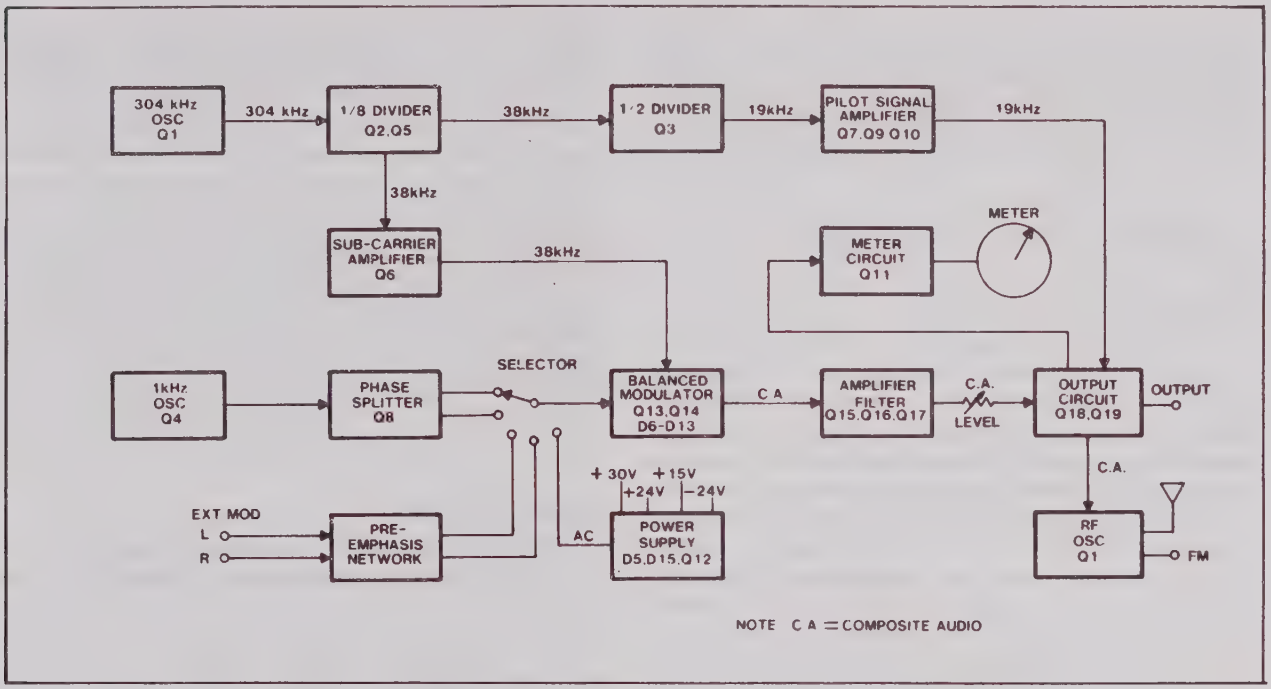


Fig. 4. Block Diagram.

mits the pre-emphasis to be set for 50 μs, 75 μs, or OFF. Variable resistor VR4 permits both inputs to be balanced for equal sensitivity.

SELECTOR Switch

SELECTOR switch S102 selects external modulation when desired, or one of five modes of internal modulation. When EXT modulation is selected, the LEFT channel input is routed to Q14 and the RIGHT channel input is routed to Q13 of the balanced modulator circuit.

INTERNAL MODULATION

1 kHz Oscillator

Transistor Q4 generates a 1 kHz signal in a Colpitts oscillator circuit. To reduce distortion, the bypass capacitor is eliminated from the base of Q4, and a negative feedback is applied to the transistor. A 1 kHz band pass filter in the emitter output further reduces distortion to approximately 0.5%. This signal is used for internal modulation. Variable resistor VR1 calibrates the output level to match external modulation sensitivity.

Phase Splitter

Transistor Q8 provides an inverted 1 kHz signal at its collector and a non-inverted 1 kHz signal at its emitter to permit (L - R) signal simulation. Close tolerance resistors are used as load resistors for Q8 to minimize the level difference between the signals. Since the impedance of the signal source differs between the collector and emitter, resistor R33 is inserted into the emitter circuit to compensate for the difference, since such level difference would affect the crosstalk factor.

SELECTOR Switch

For the five modes of internal modulation, SELECTOR switch S102 selects the inverted or non-inverted 1 kHz output of Q8 in various configurations. In the "L" mode, the non-inverted 1 kHz signal is applied to Q14 and the input of Q13 is terminated to ground through a resistor. In the "R" mode, the non-inverted 1 kHz signal is applied to Q13 and the input to Q14 is terminated. In the (L + R) mode, the non-inverted 1 kHz signal is applied to both Q13 and Q14. In the (L - R) mode, the non-

inverted signal is applied to Q14 and the inverted signal is applied to Q13. In the "L & R (line)" mode, the non-inverted 1 kHz signal is applied to Q14 and an equal amplitude sample of 50/60 Hz line voltage is applied to Q13.

COMPOSITE AUDIO GENERATION

Balanced Modulator

This circuit includes transistors Q13 and Q14 and eight diodes D6 thru D13. The two-phase 38 kHz sub-carrier from Q6 is applied across the diode switching network. A dc current is applied to the diodes in the forward direction to insure switching at the high audio modulation frequencies. Variable resistor VR7 balances the network for minimum residual 38 kHz output when no modulation is applied. An audio signal applied to Q13 or Q14 unbalances the circuit. This produces composite audio output consisting of the original audio signal and a double sideband suppressed carrier sub-band around 38 kHz. For example, in the "L" mode, Q13 has no audio output and the reference for one side of the diode network is fixed. Meanwhile, Q14 has an audio output which continually shifts the reference of the other side of the diode network throughout the audio cycle. During the unbalance, a sub-band is generated. In the (L + R) mode, identical 1 kHz signals are applied to both Q13 and Q14. Since the references to both sides of the diode network shift the same amount and in the same direction, no unbalance occurs and no sub-band is generated. However, the in-phase 1 kHz signals add in the output. In the (L - R) mode, the opposite is true. Out-of-phase 1 kHz signals are applied to Q13 and Q14. The references to both sides of the diode bridge shift in opposite directions, doubling the amount of unbalance and generating the sub-band. However, the 1 kHz signals are out-of-phase and cancel. Variable resistor VR5 equalizes Q13 and Q14.

Amplifier and Filter

The composite signal generated by the balanced modulator contains many unwanted harmonics. An induction M type low-pass filter consisting of L10, C66, C67, and C68 eliminates unwanted harmonics and prevents cross modulation. A 76 kHz trap consisting of L9, C57, and TC1 removes the second harmonic of 38 kHz which cannot be eliminated thoroughly by the low pass filter. Transistor Q15 amplifies the composite audio signal to the required level. Emitter follower Q17 acts as a buffer. The composite audio signal is developed at the emitter of Q7 and applied across LEVEL control VR103. The output of Q17 is also routed through a high pass filter in the base circuit of Q16, which passes only the sub-band. The sub-band is inverted and amplified by Q16 and fed back to Q15 to cancel any phase or level differences in the composite audio signal. Variable resistors VR8 and VR9 permit adjustment of the level and phase of this feedback signal.

Output Circuit

The output circuit includes transistors Q18 and Q19. The composite audio signal from the LEVEL control is mixed with the 19 kHz pilot signal, buffered, and applied to the OUTPUT jacks, the meter circuit, and as modulation to the rf oscillator by this circuit. The composite audio signal is injected at the base of Q19 and the pilot signal at the emitter. The output impedance is determined by the combination of R104 and R107, and is 600 ohms. R99 and Q18 are buffers for preventing the mixing action of Q19 from being affected by the setting of VR103. The output level is variable from 0 to 2 volts rms by means of the LEVEL control, VR103.

RF GENERATION

Transistor Q1 operates as a Colpitts oscillator. The oscillator operates in the 98 MHz band, or when C105 and C106 are switched in by S104, the 85 MHz band. The carrier frequency within either band is adjustable by TC101. When S104 is in the OFF position, power is removed from Q1 and no rf output is obtained. The rf output is extracted from the emitter for low distortion and applied to the antenna jack and through matching transformer L101 to the 300-ohm balanced FM OUT terminal. Direct FM modulation is achieved by varactor diode D1. The composite audio signal is applied to D1, which varies in capacitance in proportion to the applied voltage. A dc current is applied through D1 to reduce modulation distortion which would result if the diode were permitted to rectify. Variable

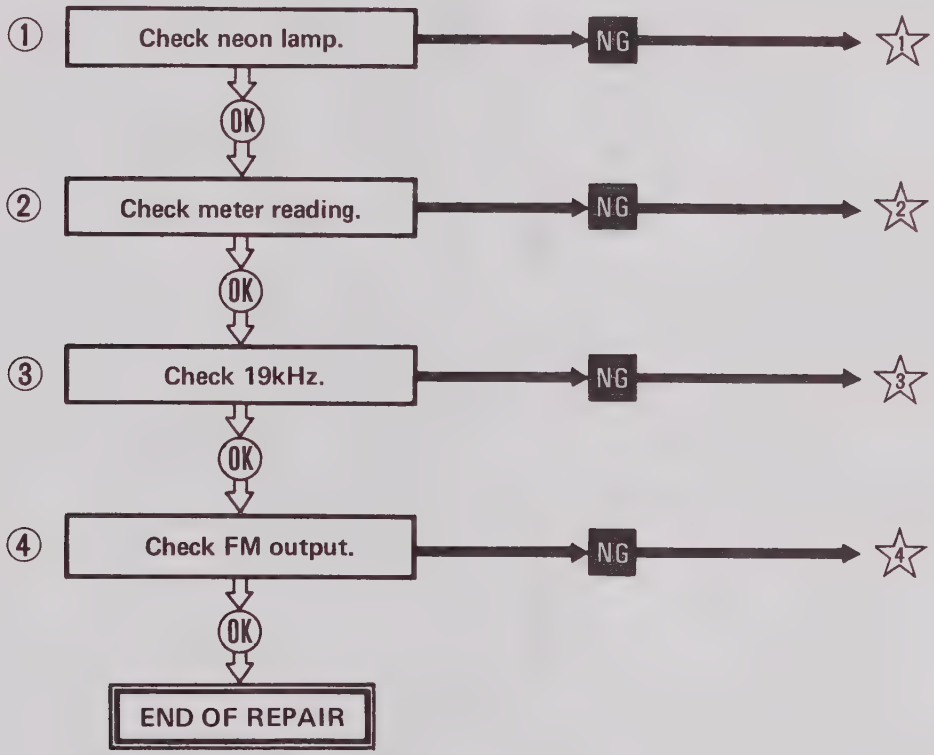
resistor VR3 calibrates FM deviation for the 98 MHz band and VR1 corrects FM deviation for the 85 MHz band.

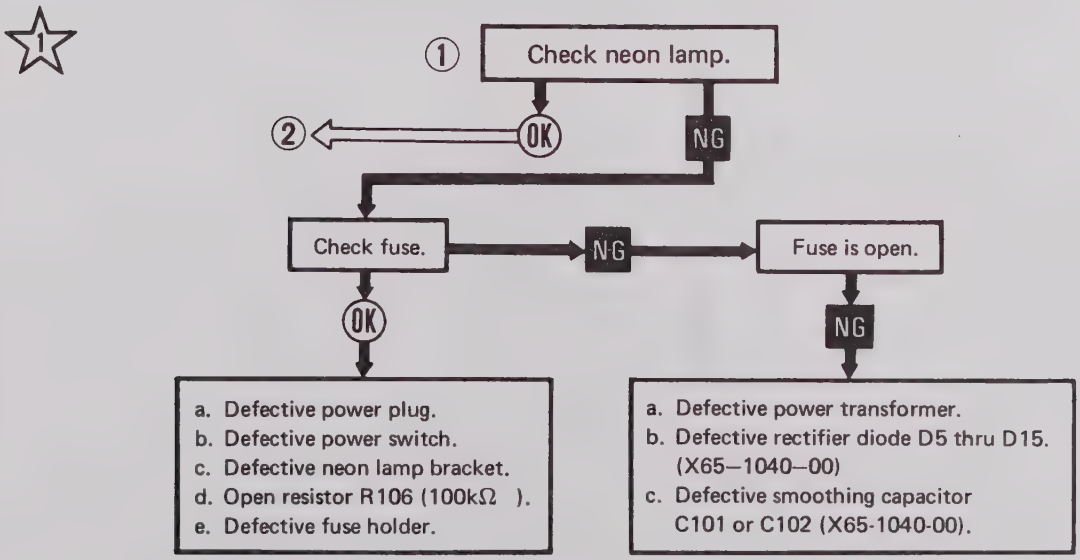
METER CIRCUIT

The output of Q19, composite audio with pilot signal combined, is applied to the meter circuit consisting of transistor Q11, full wave rectifiers D1 and D2, and the meter. The rectifiers convert the audio signal to dc to deflect the meter. Variable resistor VR2 calibrates the meter.

POWER SUPPLY

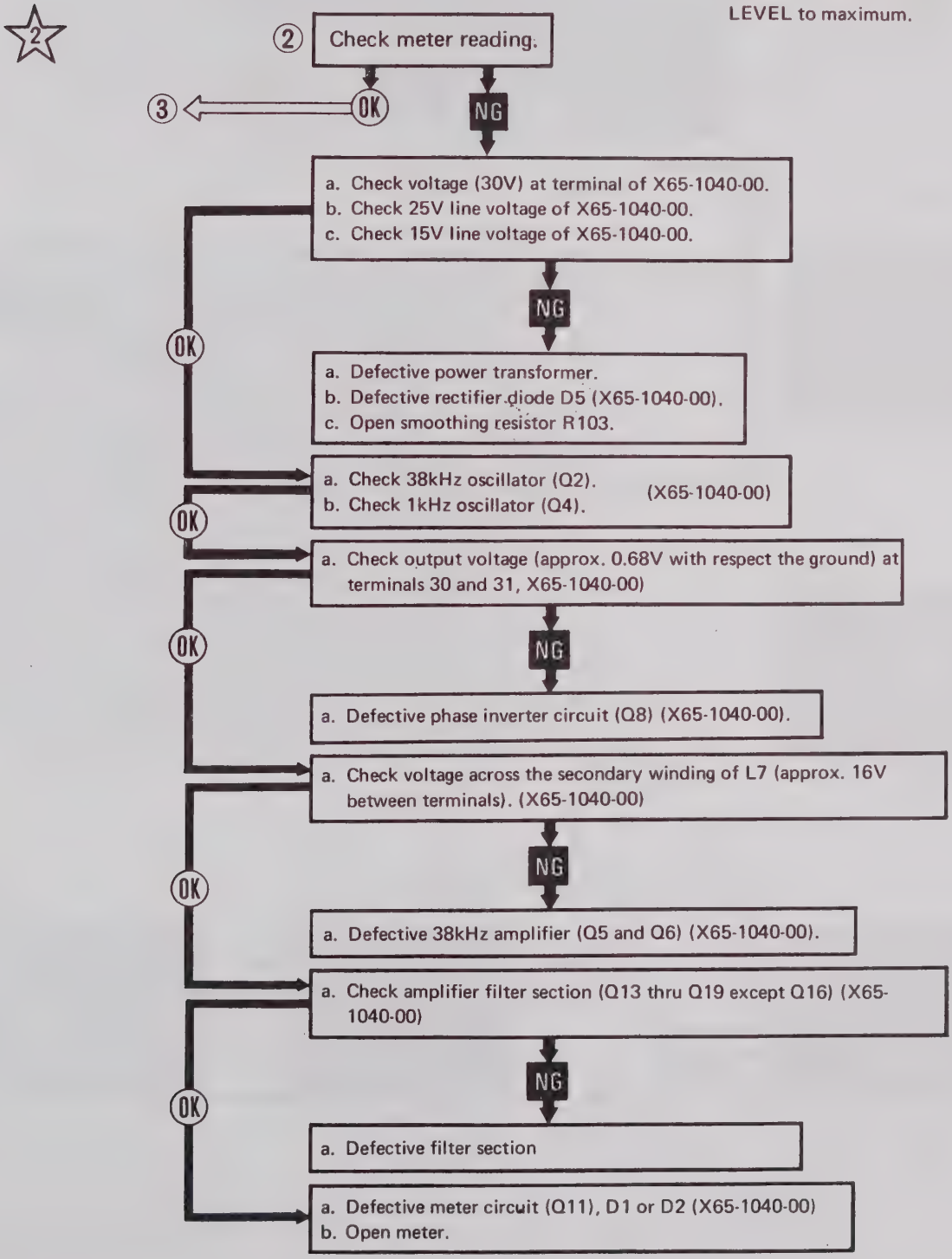
Power transformer T101 has a tapped primary, permitting operation from 100, 117, or 230 volts by inserting a fuse in the proper fuseholder. Neon lamp N101 lights when power is applied to the primary, acting as a pilot light. The center tapped secondary provides stepped down ac voltage to full wave rectifiers D5 and D15. The output of D5 is filtered to become unregulated +30 volt dc source. The +30 volts is also regulated to +24 volts by transistor Q12, with Zener diode D4 establishing its reference voltage. The +24 volts is also regulated to +15 volts by Zener diode D3. Full wave rectifier D15, in conjunction with Zener diode D14, provides a -24 volt source for forward biasing the diodes of the balanced modulator. The secondary voltage from T101 is also filtered to eliminate high frequency noise and developed across VR6. VR6 sets the level of the 50/60 Hz component into the R channel in the L & R (LINE) mode of modulation.

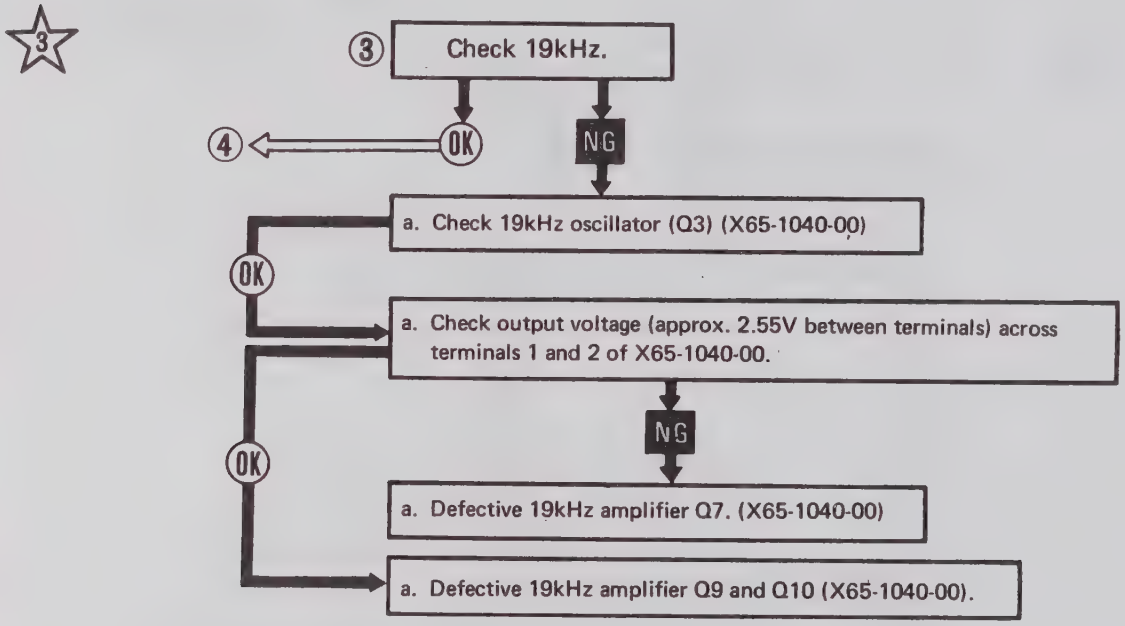


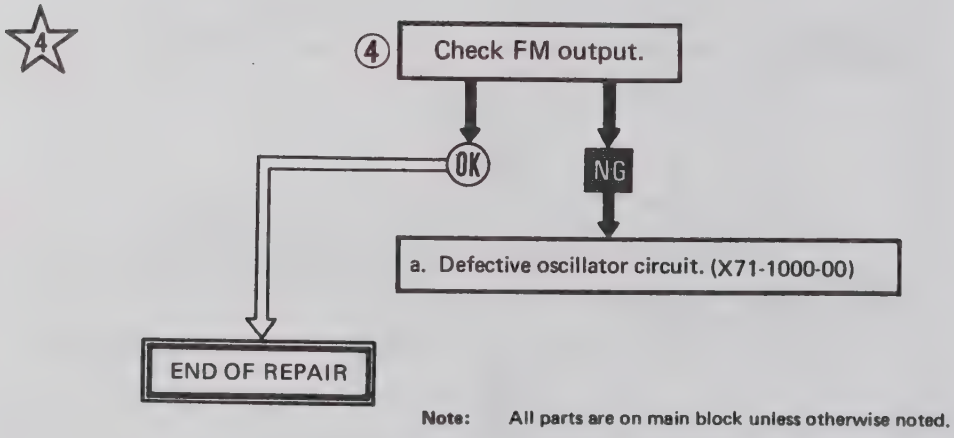


Note: All parts are on main block Y78-1000-00 unless otherwise noted.

Conditions: Set SELECTOR to any position except EXT, and LEVEL to maximum.


2
Check meter reading.
OK
3
NG
a. Check voltage (30V) at terminal of X65-1040-00.
b. Check 25V line voltage of X65-1040-00.
c. Check 15V line voltage of X65-1040-00.
NG
OK
a. Defective power transformer.
b. Defective rectifier diode D5 (X65-1040-00).
c. Open smoothing resistor R103.
a. Check 38kHz oscillator (Q2).
b. Check 1kHz oscillator (Q4).
(X65-1040-00)
OK
a. Check output voltage (approx. 0.68V with respect the ground) at terminals 30 and 31, X65-1040-00)
OK
NG
a. Defective phase inverter circuit (Q8) (X65-1040-00).
a. Check voltage across the secondary winding of L7 (approx. 16V between terminals). (X65-1040-00)
OK
NG
a. Defective 38kHz amplifier (Q5 and Q6) (X65-1040-00).
a. Check amplifier filter section (Q13 thru Q19 except Q16) (X65-1040-00)
OK
NG
a. Defective filter section
a. Defective meter circuit (Q11), D1 or D2 (X65-1040-00)
b. Open meter.

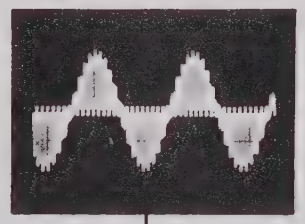


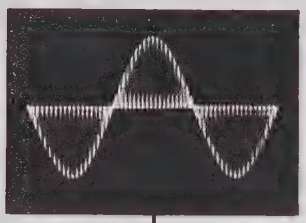


Note: All parts are on main block unless otherwise noted.

PHOTOGRAPH G
6.4Vp-p max

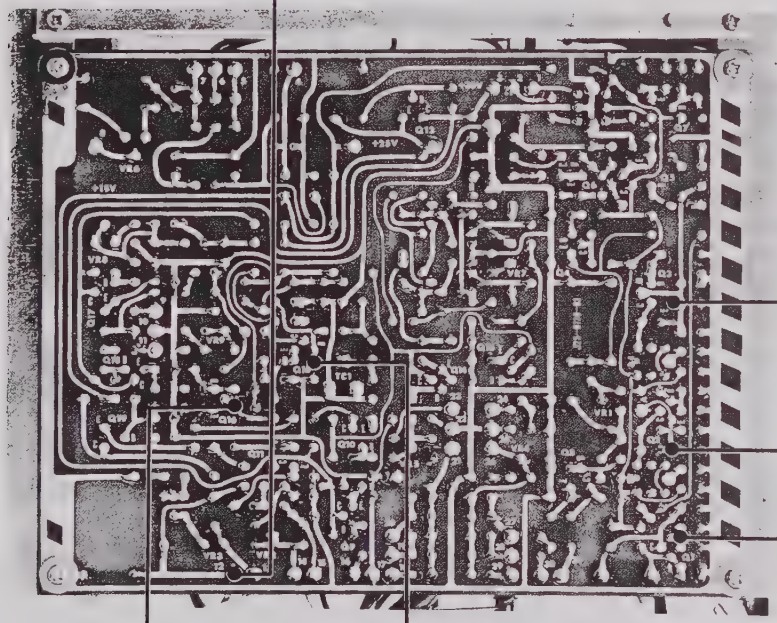
Waveform at the output terminal, 19kHz pilot signal superimposed on the composite signal of PHOTO F.



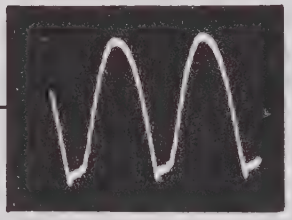


PHOTOGRAPH F
6.2Vp-p max

Amplified waveform of the composite signal at the output terminal, the harmonic components have been eliminted from the signal by the low-pass filter.

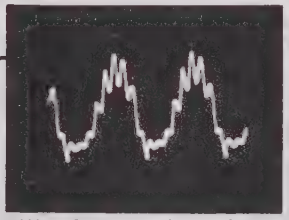


PHOTOGRAPH B
2.25Vp-p



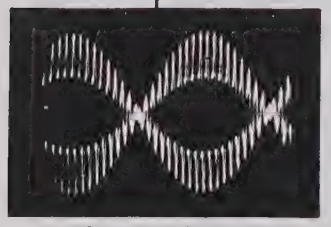
Waveform at the emitter of Q3, 19kHz oscillator circuit.

PHOTOGRAH A
1.25Vp-p



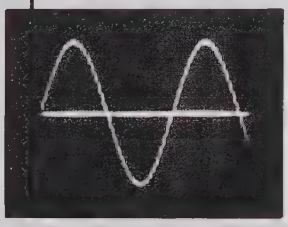
Waveform at the emitter of Q2, 38kHz oscillator circuit.

PHOTO
GRAPH E 1.25Vp-p



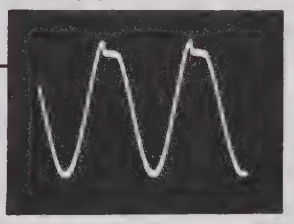
Waveform at the collector of Q16. This sub-channel component is extracted from the composite signal by the high-pass filter and amplified by Q16.

PHOTOGRAPH D
1.6Vp-p



Composite waveform at the base of Q15 past switching circuit D6 thru D13.

PHOTOGRAPH C
4.5Vp-p



Waveform at the collector of Q1, 304kHz crystal oscillator circuit.

CALIBRATION

GENERAL

This instrument was calibrated at the factory before shipment. Readjustment is recommended only if repairs have been made in a circuit affecting calibration, or if you have reason to believe the unit may be out of calibration. Complete calibration procedures are given in this manual. However, calibration adjustments should be attempted only if the proper test equipment is available, and you are experienced and qualified in its use. If the accuracy of the test equipment used for calibration is less than specified, the accuracy of the FM Stereo Generator will be degraded proportionately. Perform related adjustments only in the specified sequence to prevent undesirable interaction of adjustments.

TEST EQUIPMENT REQUIRED

DC Voltmeter, 1% or better accuracy at 100 mV to 200 V (**B & K-Precision** Model 2816 or 2831 or equivalent).

Low distortion audio signal generator. (**B & K-Precision** Model 3010 or 3020 or equivalent).

Oscilloscope, 5 mV per division sensitivity or greater, bandwidth 100 MHz or greater (**B & K-Precision** Model 1590A or equivalent).

100 MHz Frequency Counter, 10 ppm time base (**B & K-Precision** Model 1822 or equivalent).

Wideband AC Voltmeter (**B & K-Precision** Model 295 or 297 or equivalent).

Calibrated FM Deviation Monitor, includes 83 MHz - 100 MHz band, measures 0-75 kHz deviation within ±2%.

PRELIMINARY PROCEDURE

Make sure that line voltage is within ±10% of specified value. Calibration should be performed only at ambient room temperature of 10° to 35° C and at relative humidity of less than 85%. Warm up this instrument and calibrating instruments thoroughly (30 minutes) before starting. Perform adjustments in the specified sequence.

Unless otherwise specified, the 19 KHz switch and the PRE-EMPHASIS switch of the Model 2007 should be set to OFF during calibration adjustments.

38 kHz FREQUENCY DIVIDER ADJUSTMENT

1. Connect an oscilloscope to view the waveform at the emitter of Q2 (Test Point A).
2. Connect a frequency counter to measure the frequency at the secondary winding of L7 (Junction of L7 and R23).
3. Unthread the slug of coil L2 to the upper end, then return it. In returning the slug, find where synchronization is lost (as observed on oscilloscope) and take note of this point. Then, further thread the slug in until it reaches the lower end. Here, turn the Model 2007 POWER switch off, then on, and back up the slug until the synchronization is again lost. The point at which the slug is to be finally set is the mechanical midpoint of the difference between the first and second points where synchronization was lost.
4. The frequency counter should read 38.000 kHz ±4 Hz.

19 kHz FREQUENCY DIVIDER ADJUSTMENT

1. Connect an oscilloscope to view the waveform at the emitter of Q3 (Test Point B).
2. Connect a frequency counter to measure the frequency at the secondary winding of L8 (Junction of L8 and C31).

3. Adjust the slug of coil L3 in the same manner as the 38 kHz Frequency Divider Adjustment.
4. The frequency counter should read 19.000 kHz ±2 Hz.

38 kHz AMPLIFIER LEVEL ADJUSTMENT

1. Connect an oscilloscope to view the waveform at the secondary winding of L7 (Junction of L7 and R23).
2. Adjust the slug of L7 for maximum amplitude waveform on the oscilloscope.

BALANCE ADJUSTMENT

1. Set the SELECTOR switch to the EXT position, with no input applied to the EXT INPUT terminals.
2. Set the LEVEL control to maximum.
3. Connect a wideband ac voltmeter to measure the voltage at the COMPOSITE OUTPUT terminals.
4. Adjust VR7 for minimum reading on the ac voltmeter (minimum leakage).

INTERNAL MODULATION GAIN ADJUSTMENT

1. Set the SELECTOR switch to the (L + R) position.
2. Set the LEVEL control to maximum.
3. Connect an oscilloscope to measure the waveform at the COMPOSITE OUTPUT terminals.
4. Adjust VR1 so that the oscilloscope waveform is approximately 6.0 volts peak-to-peak.
5. Adjust VR5 and TC1 so that the milling disappears from the waveform on the oscilloscope.

EXTERNAL MODULATION GAIN ADJUSTMENT

1. Set the SELECTOR switch to the EXT position.
2. Set the LEVEL control to maximum.
3. Apply the same 1 kHz, 2 V rms signal from an audio generator to both the LEFT and RIGHT external input terminals in parallel.
4. Connect an oscilloscope to view the waveform at the COMPOSITE OUTPUT terminals.
5. Adjust VR4 to minimize the milling on the waveform of the oscilloscope.

SEPARATION ADJUSTMENT

1. Set the SELECTOR switch to the EXT position.
2. Set the LEVEL control to maximum.
3. Connect an oscilloscope to view the waveform at the COMPOSITE OUTPUT terminals.
4. Alternately apply 1 kHz and then 10 kHz, 2 V rms signals from an audio generator to the EXT INPUT terminals. Apply the same signal in parallel to the LEFT and RIGHT inputs.
5. Adjust the level difference at 1 kHz with VR8, and the phase deviation at 10 kHz with VR9, referring to PHOTO F in the TROUBLESHOOTING section of this manual. Repeat these adjustments 2 or 3 times to minimize interaction.

METER CALIBRATION

1. Set the SELECTOR switch to the EXT position.
2. Apply the same 1 kHz, 2 V rms signal from an audio generator to the LEFT and RIGHT external input terminals in parallel. This signal level should be measured and set accurately to 2.0 volts.
3. Connect a wideband ac voltmeter to measure the voltage at the COMPOSITE OUTPUT terminals.
4. Adjust the LEVEL control so the ac voltmeter reads 2.0 volts.
5. Adjust VR2 so that the front panel meter of the Model 2007 (M1) reads a full scale value of 2.0 volts.

6. Set the SELECTOR switch to the (L + R) position.
7. Adjust VR1 so the front panel meter (M1) again reads the 2.0 volts full scale value.

LINE LEVEL ADJUSTMENT

1. Set the SELECTOR switch to the L & R (LINE) position.
2. Set the LEVEL control to maximum.
3. Connect a dual-trace oscilloscope to measure the LINE waveform from VR6 (terminal 8 of X65-1040-00) and the 1 kHz internal modulation waveform (terminal 30 of X65-1040-00).
4. Adjust VR6 so the level of the LINE signal equals the level of the 1 kHz internal modulation signal.

19 kHz PILOT SIGNAL ADJUSTMENTS

1. Set the SELECTOR switch to the "L" or "R" position.
2. Set the LEVEL control to maximum.
3. Set VR101 (19 KHz PHASE control) to its midpoint.
4. Connect a wideband ac voltmeter to measure the voltage across the secondary winding of L8.
5. Adjust the slug of L8 for maximum reading on the ac voltmeter.
6. Set the SELECTOR switch to the EXT position with no input applied to the EXT INPUT terminals.
7. Set the 19 kHz switch to ON.
8. Connect the wideband ac voltmeter to measure the voltage at the COMPOSITE OUTPUT terminals.
9. Adjust VR102 (19 KHz LEVEL control) for an ac voltmeter reading of 0.2 volt.

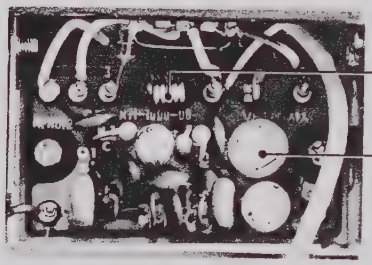
RF FREQUENCY ADJUSTMENT (X71-1000-00)

1. Set the frequency selector switch to the 98 MHz position and the FREQ. ADJ. control (TC101) to the midpoint of its variable range.
2. Connect a frequency counter to measure the rf carrier frequency from the antenna or the FM OUTPUT terminals.
3. Adjust the gap of L1 until the frequency counter reads 98 MHz.

FREQUENCY DEVIATION ADJUSTMENT (X71-1000-00)

1. Set the SELECTOR switch to the (L + R) position.
2. Set the frequency selector switch to the 98 MHz position.
3. Adjust the LEVEL control until the front panel meter of the Model 2007 (M1) deflects exactly full scale (75 kHz).
4. Connect a calibrated FM deviation monitor to measure the rf output from the antenna or the FM OUTPUT terminals.
5. Adjust VR3 (X65-1040-00) to obtain a frequency deviation reading of 75 kHz on the calibrated FM deviation monitor.
6. Then, set the frequency selector switch to 85 MHz and retune the deviation monitor to measure the rf output.
7. Adjust VR1 (X71-1000-00) so the frequency deviation reading is again 75 kHz on the calibrated FM deviation monitor.

X71-1000-00



L1 FM frequency adjustment

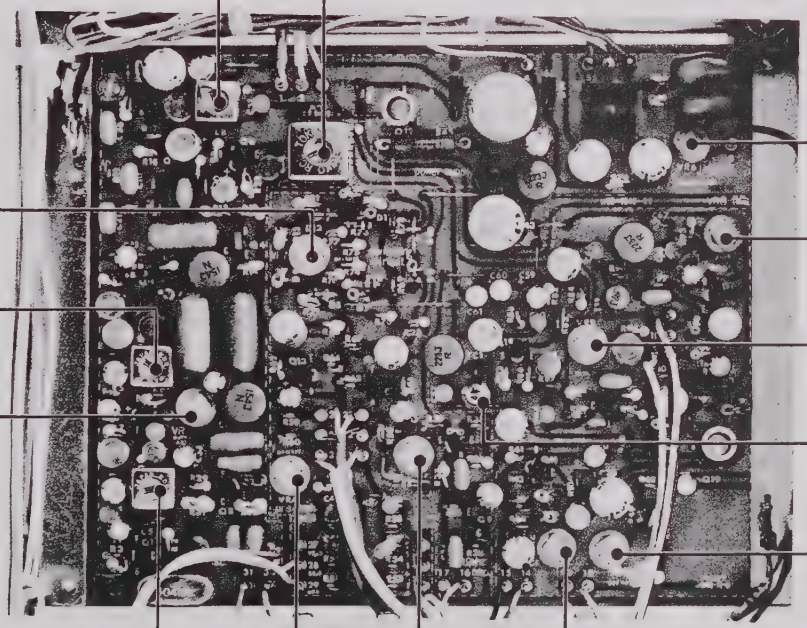
VR1 Frequency deviation adjustment

Rear

L8 Adjust the phase, and voltage to maximum (19kHz).

L7 Adjust voltage to maximum (38kHz).

X65-1040-00



VR6 Line voltage adjustment

VR7 Leakage adjustment

VR8 Separation level adjustment

L3 19kHz oscillator frequency adjustment

VR9 Separation phase adjustment

VR1 1kHz output adjustment

TC1 76kHz trap

VR3 Frequency deviation adjustment

VR2 Meter sensitivity adjustment

L2 38kHz oscillator frequency adjustment

VR4 External modulation gain adjustment

VR5 Internal modulation gain adjustment

Front

PARTS LIST

This section includes pictorial views of the instrument with accompanying mechanical parts list, and an electrical parts list referenced to the schematic diagrams.

U.S.A. PARTS ORDERING INFORMATION

There is a minimum charge for each invoice. Orders will be shipped C.O.D unless previous open account arrangements have been made or remittance accompanies order. Advance remittance must cover handling, postage or express charges. Specify model and serial number when ordering replacement parts.

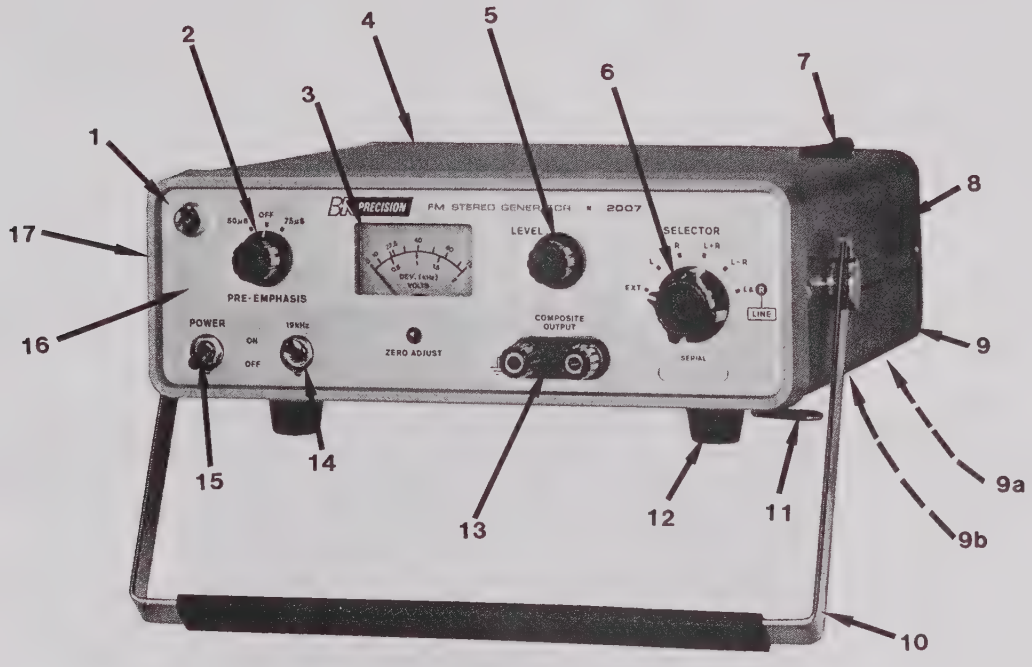
ORDER REPLACEMENT PARTS FROM

B & K-Precision, Dynascan Corporation
Factory Service Operations
4050 North Ravenswood Avenue
Chicago, Illinois 60613
Tel (312) 327-7270
Telex: 25-3475

INDEX NUMBER	DESCRIPTION	DYNASCAN PART NUMBER
1	Neon Bulb, N101	401-029-9-001
2	Knob (PRE-EMPHASIS)	751-124-9-001
3	Meter, M1	320-125-9-001
4	Case (Upper)	272-174-9-001
5	Knob (LEVEL)	751-124-9-001
6	Knob (SELECTOR)	751-124-9-002
7	Rubber Antenna Cap.	380-498-9-002
8	Rubber Antenna Cap.	380-498-9-002
9	Case (Lower)	272-175-9-001
9-a	Cover, Fuse Compartment	763-198-9-001
9-b	Screw, for Fuse Compartment Cover (special)	634-187-9-001
10	Handle	746-072-9-001
11	Power Cord Holder	741-171-9-001
12	Rubber Foot	381-054-9-001
13	Dual Binding Post (COMPOSITE OUTPUT)	773-132-9-001
14	Toggle Switch (19 KHz), S103	085-011-9-002
15	Toggle Switch (POWER), S105	085-011-9-001
16	Front Panel	255-235-9-001
17	Escutcheon	380-498-9-001
18	Slide Switch (MHz), S104	084-022-9-001
19	Dual Binding Post (FM OUTPUT)	773-132-9-001
20	19 KHz LEVEL Control, VR102	008-489-9-001
21	Dual Binding Post (LEFT EXT. INPUT)	773-132-9-001
22	Dual Binding Post (RIGHT EXT. INPUT)	773-132-9-001
23	Power Cord	420-013-9-001
24	19 KHZ PHASE Control, VR101	008-489-9-001
25	Rear Panel	262-057-9-001
26	Escutcheon	380-498-9-001
27	FREQ. ADJUST Control, TC101	029-018-9-001
28	Power Transformer, T101	065-081-9-001
29	Capacitor, 1000 µF, 50 V, C101	022-286-9-001
30	Capacitor, 1000 µF, 50 V, C102	022-286-9-001
31	Mounting Board, Antenna	251-588-9-001
32	Chassis	257-153-9-001
33	Rotary Switch (SELECTOR), S102	083-304-9-002
34	19 KHz LEVEL Control, VR102	008-169-9-001
35	Rotary Switch (PRE-EMPHASIS), S101	083-304-9-001
36	Fuse Label	600-132-9-001
37	Fuse Holder	742-047-9-001
38	Chassis	257-152-9-001
	X71-1000-00 FM Oscillator Assembly	523-606-9-001
	X65-1040-00 Amplifier Assembly	523-604-9-001

UNREFERENCED PARTS

Packing Carton	500-636-9-001
Formed Styrene Pad (for packing carton)	502-183-9-001
Formed Stryene Pad (for packing carton)	502-183-9-002
Instruction Manual	480-432-9-001
Schematic Diagram & Parts List	499-316-9-001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9a
9b
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POWER
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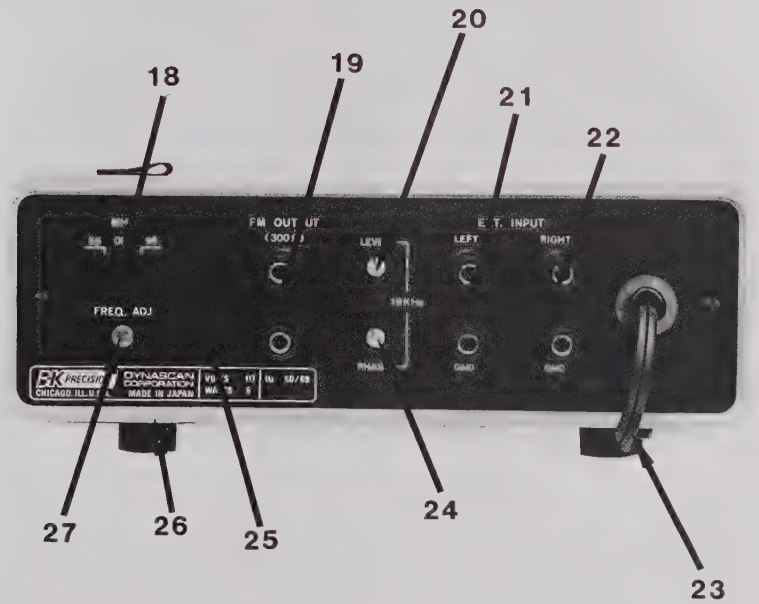
19kHz
ZERO ADJUST
COMPOSITE OUTPUT
LEVEL
SELECTOR
LINE
SERIAL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LEFT
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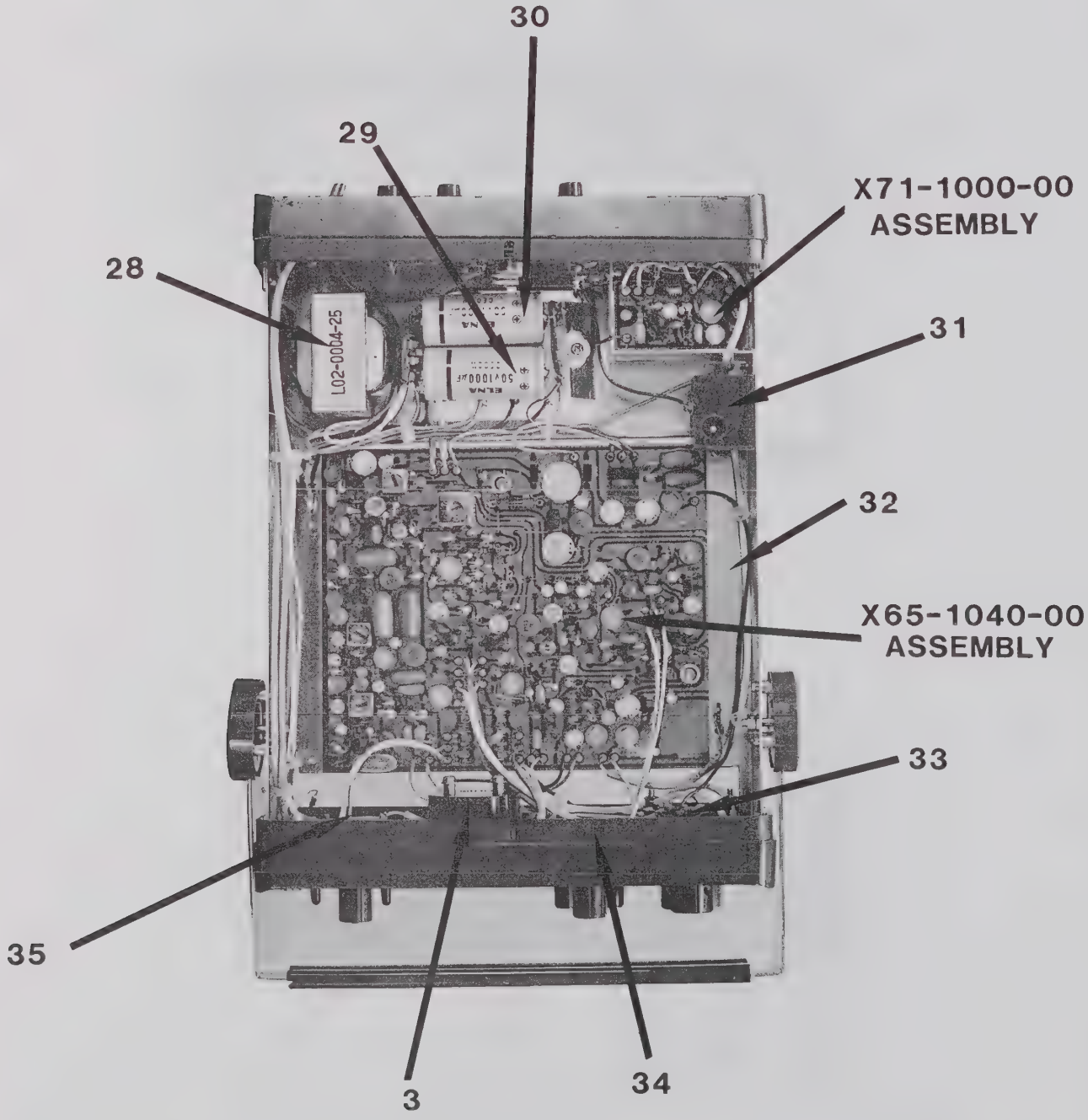
FREQ. ADJ
PHASE
DYNASCAN CORPORATION
MADE IN JAPAN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X65-1040-00
ASSEMBLY
33
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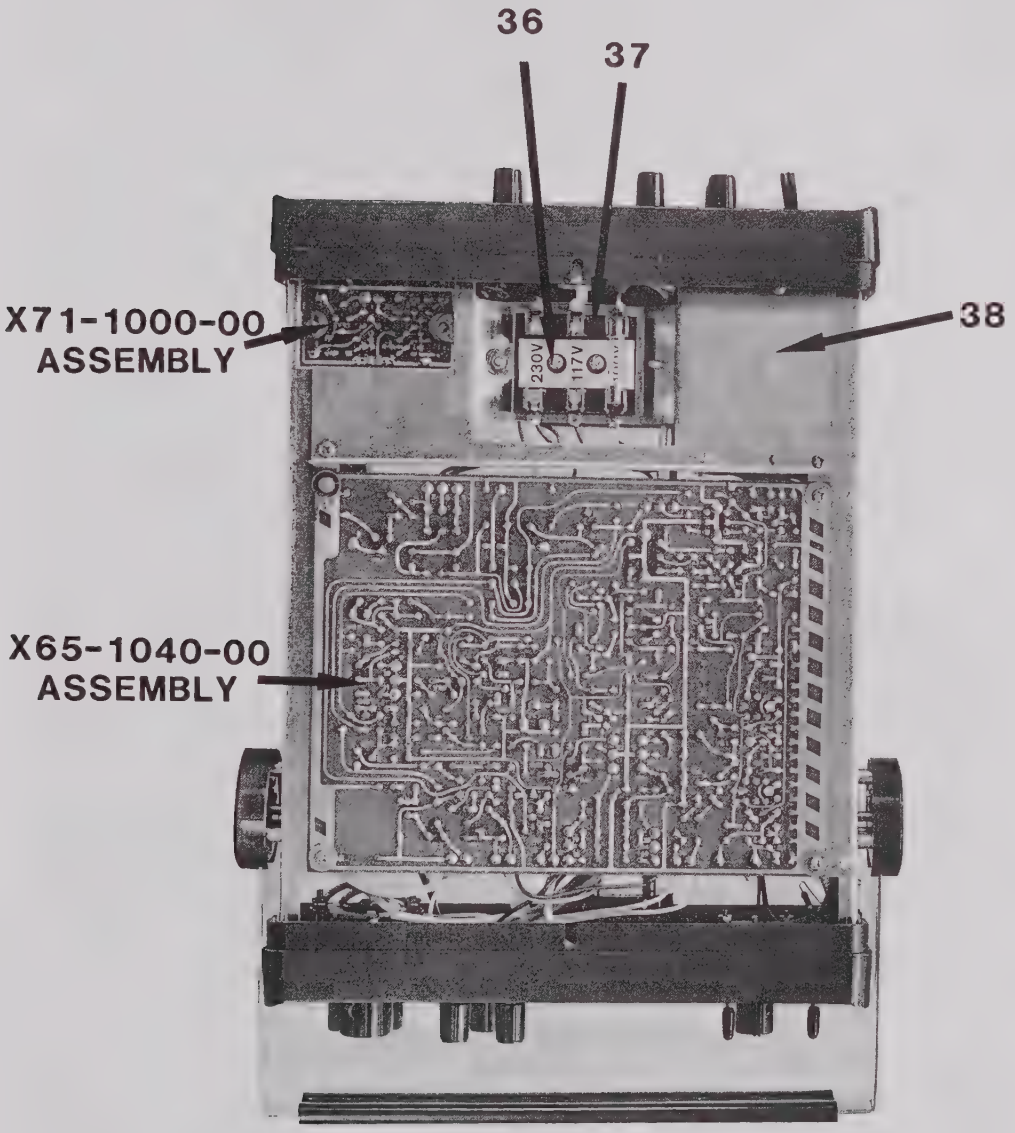

36
37
X71-1000-00
ASSEMBLY
38
230V
117V
X65-1040-00
ASSEMBLY

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NUMBER

CHASSIS ASSEMBLY

RESISTORS

Unlisted resistors are ±5%, 1/4W. See schematic diagram for value.

R103	100 Ω ±5%, 2 W Metal Film	011-002-5-101
VR101, 102	50 kΩ Potentiometer (19 kHz PHASE or 19 kHz LEVEL)	008-489-9-001
VR103	10 kΩ Potentiometer (Level Control)	008-169-9-001

CAPACITORS

C101,102	1000 µF, 50 V Electrolytic	022-286-9-001
C103	5 pF ±0.25 pF, 50 V Ceramic	020-246-9-002
C104	22 pF ±5%, 50 V Ceramic	020-124-9-007
C105	1 pF ±0.25 pF, 50 V Ceramic	020-342-9-001
C106	5 pF ±0.25 pF, 50 V Ceramic	020-246-9-002
TC101	6 pF Variable	029-018-9-001

SWITCHES

S101	3-Position Rotary (PRE-EMPHASIS)	083-304-9-001
S102	6-Position Rotary (SELECTOR)	083-304-9-002
S103	SPDT Toggle (19 KHz)	085-011-9-002
S104	3-Position Slide (98 MHz-OFF-85 MHz)	084-022-9-001
S105	SPST Toggle (POWER)	085-011-9-001

MISCELLANEOUS

L101	Matching Coil	068-014-9-001
M1	Meter	320-125-9-001
N101	Neon Lamp (Pilot Light)	401-029-9-001
T101	Power Transformer	065-081-9-001

FM OSCILLATOR ASSEMBLY (X71-1000-00)

RESISTORS

Unlisted resistors are ±5%, 1/4W. See schematic diagram for value.

VR1	47 kΩ Trimmer	008-155-9-003

CAPACITORS

C1	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C2	100 pF ±5%, 50 V Ceramic	020-341-9-005
C3	5 pF ±0.25 pF 50 V Ceramic	020-246-9-002

SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NUMBER
C4, 5	22 pF ±5%, 50 V Ceramic	020-124-9-007
C6	10 µF, 25 V Electrolytic	022-130-9-002
C7	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C8	47 µF, 16 V Electrolytic	022-073-9-004
C9	33 pF ±5%, 50 V Ceramic	020-103-9-002
C10	10 pF ±0.5 pF 50 V Ceramic	020-144-9-007
	DIODES	
D1	1S2075K, Diode	151-028-9-001
	TRANSISTORS	
Q1	2SC458(C) Silicon NPN	176-016-9-001
	MISCELLANEOUS	
L1	Oscillator Coil	046-041-9-001

AMPLIFIER ASSEMBLY (X65-1040-00)

RESISTORS

Unlisted resistors are ±5%, 1/4W. See schematic diagram for value.

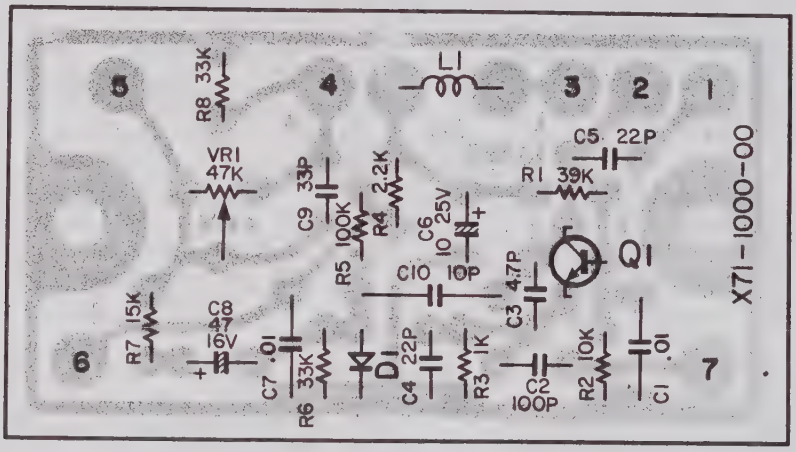
R45	270 Ω ±5%, 2 W Metal Film	011-002-5-271
R104	1 kΩ ±5%, 2 W Metal Film	011-002-5-102
R105	560 Ω ±5%, 1/2 W Carbon	002-102-5-561
VR1	22 kΩ Trimmer	008-163-9-010
VR2	4.7 kΩ Trimmer	008-155-9-002
VR3	47 kΩ Trimmer	008-155-9-003
VR4	22 kΩ Trimmer	008-163-9-010
VR5	100 kΩ Trimmer	008-155-9-001
VR6, 7	47 kΩ Trimmer	008-155-9-003
VR8	100 kΩ Trimmer	008-155-9-001
VR9	6.8 kΩ Trimmer	008-169-9-009
	CAPACITORS	
C1	1000 pF ±10%, 50 V Ceramic	020-249-9-001
C2	1 µF, 50 V Electrolytic	022-073-9-001
C3	10 µF, 25 V Electrolytic	022-130-9-002
C4	470 pF ±5%, 50 V Mylar	025-221-9-007
C5	100 pF ±5%, 50 V Ceramic	020-341-9-005
C6	1 µF, 50 V Electrolytic	022-073-9-001
C7	1500 pF ±10%, 50 V Mylar	025-107-9-005
C8	470 pF ±5%, 50 V Mylar	025-221-9-007
C9	4700 pF ±10%, 50 V Mylar	025-107-9-007
C10	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C11	1 µF, 50 V Electrolytic	022-073-9-001
C12	4700 pF ±5%, 50 V Mylar	025-221-9-008

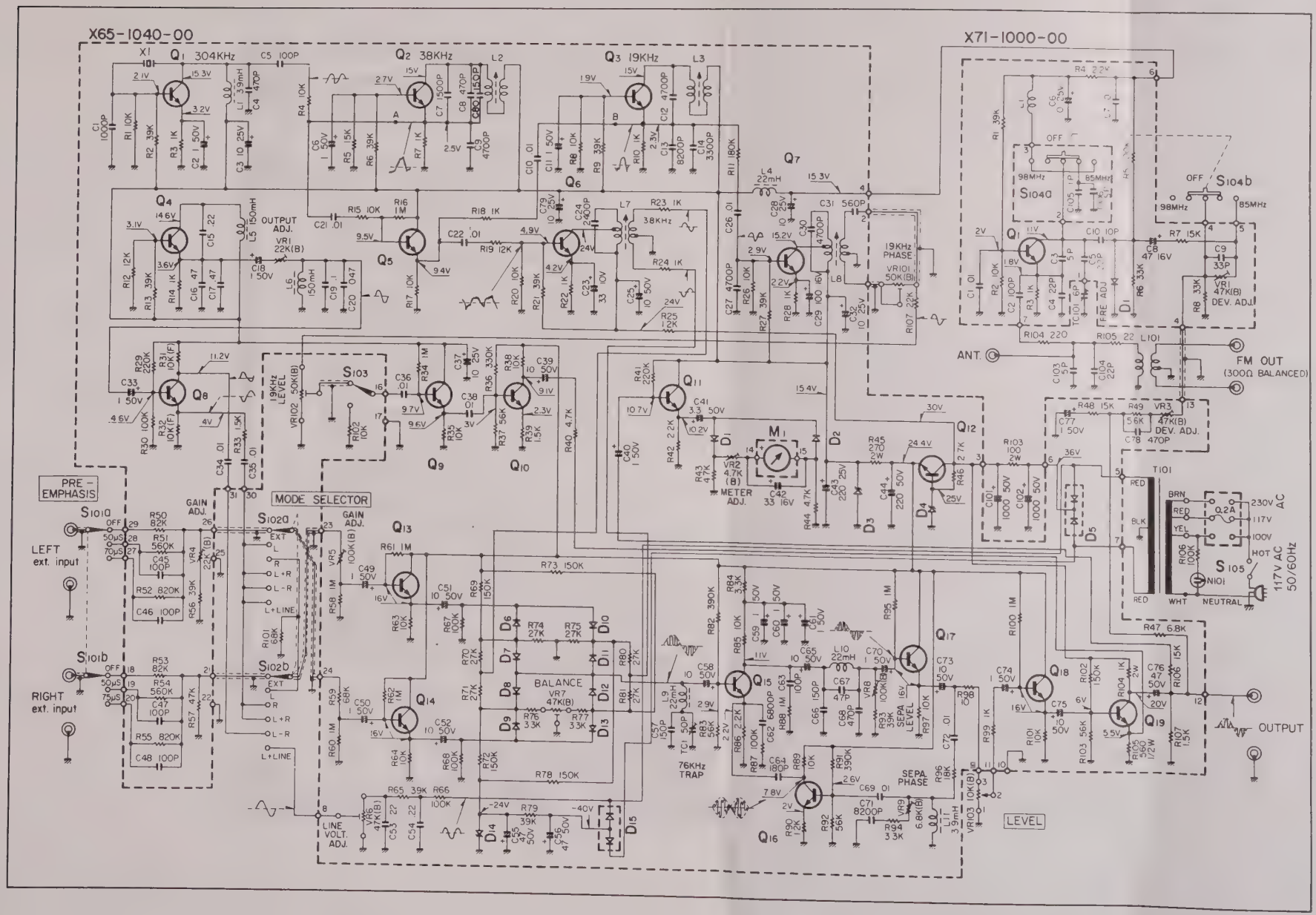
SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NUMBER
C13	8200 pF ±5%, 50 V Mylar	025-221-9-011
C14	3300 pF ±5%, 50 V Mylar	025-221-9-005
C15	0.22 µF ±10%, 50 V Mylar	025-056-9-006
C16, 17	0.47 µF ±10%, 50 V Mylar	025-076-9-003
C18	1 µF, 50 V Electrolytic	022-073-9-001
C19	0.1 µF ±10%, 50 V Mylar	025-110-9-003
C20	0.047 µF ±10%, 50 V Mylar	025-104-9-001
C21, 22	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C23	33 µF, 10 V Electrolytic	022-286-9-002
C24	2400 pF ±5%, 50 V Mylar	025-221-9-004
C25	10 µF, 50 V Electrolytic	022-286-9-004
C26	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C27	4700 pF ±5%, 50 V Mylar	025-221-9-008
C28	10 µF, 25 V Electrolytic	022-130-9-002
C29	100 µF, 16 V Electrolytic	022-073-9-002
C30	4700 pF ±5%, 50 V Mylar	025-221-9-008
C31	560 pF ±5%, 50 V Mylar	025-221-9-009
C32	10 µF, 25 V Electrolytic	022-130-9-002
C33	1 µF, 50 V Electrolytic	022-073-9-001
C34-36	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C37	10 µF, 25 V Electrolytic	022-130-9-002
C38	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C39	10 µF, 50 V Electrolytic	022-286-9-004
C40	1 µF, 50 V Electrolytic	022-073-9-001
C41	3.3 µF, 50 V Electrolytic	022-199-9-001
C42	33 µF, 16 V Electrolytic	022-123-9-004
C43	220 µF, 25 V Electrolytic	022-286-9-003
C44	220 µF, 50 V Electrolytic	022-073-9-006
C45-48	100 pF ±5%, 50 V Mylar	025-221-9-001
C49, 50	1 µF, 50 V Electrolytic	022-073-9-001
C51, 52	10 µF, 50 V Electrolytic	022-286-9-004
C53, 54	0.22 µF ±10%, 50 V Mylar	025-056-9-006
C55, 56	47 µF, 50 V Electrolytic	022-087-9-002
C57	150 pF ±5%, 50 V Mylar	025-221-9-002
C58	10 µF, 50 V Electrolytic	022-286-9-004
C59-61	1 µF, 50 V Electrolytic	022-073-9-001
C62	6800 pF ±5%, 50 V Mylar	025-221-9-010
C63	100 pF ±5%, 50 V Mylar	025-221-9-001
C64	180 pF ±5%, 50 V Mylar	025-221-9-003
C65	10 µF, 50 V Electrolytic	022-286-9-004
C66	150 pF ±5%, 50 V Mylar	025-221-9-002
C67	47 pF ±5%, 50 V Mylar	025-221-9-006
C68	470 pF ±5%, 50 V Mylar	025-221-9-007
C69	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C70	1 µF, 50 V Electrolytic	022-073-9-001
C71	8200 pF ±5%, 50 V Mylar	025-221-9-011
C72	0.01 µF ±10%, 50 V Mylar	025-136-9-001
C73	10 µF, 50 V Electrolytic	022-286-9-004
C74	1 µF, 50 V Electrolytic	022-073-9-001
C75	10 µF, 50 V Electrolytic	022-286-9-004
C76	47 µF, 50 V Electrolytic	022-087-9-002

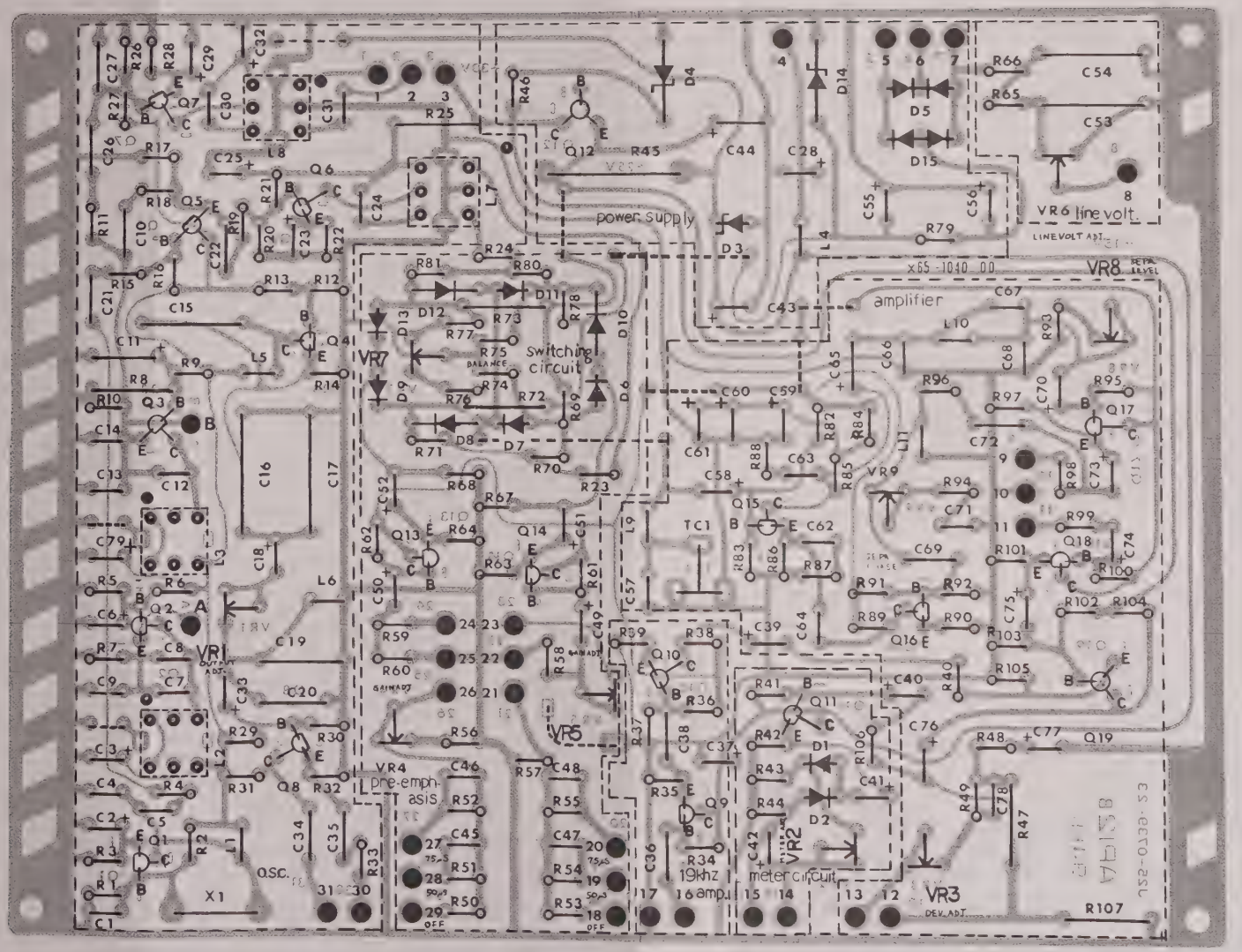
SCHEMATIC SYMBOL	DESCRIPTION	DYNASCAN PART NUMBER
C77	1 µF, 50 V Electrolytic	022-073-9-001
C78	470 pF ±10%, 50 V Ceramic	020-248-9-002
C79	10 µF, 25 V Electrolytic	022-130-9-002
C80	150 pF ±5%, 50 V Mylar	025-221-9-002
TC1	50 pF Trimmer	028-020-9-001
	DIODES	
D1, 2	1N60 Germanim Diode	150-001-9-005
D3	MTZ16JA, Zener Diode, 16 V	152-134-9-002
D4	RD24AN, Zener Diode, 24 V	152-137-9-001
D5	MI152, Rectifier Diode Pair	151-119-9-001
D6-13	1S2075K Silicon Diode	151-028-9-001
D14	RD24AN, Zener Diode, 24 V	152-137-9-001
D15	MI152R, Rectifier Diode Pair	151-119-9-002
	TRANSISTORS	
Q1-11	2SC458 (C) Silicon NPN	176-016-9-001
Q12	2SC1419 (C) Silicon NPN	176-055-9-004
Q13-18	2SC458 (C) Silicon NPN	176-016-9-001
Q19	2SC1212A (C) Silicon NPN	176-159-9-001
	INDUCTORS	
L1	Inductor, 3.9 mH	041-150-9-002
L2, 3	MPX Coil	068-014-9-002
L4	Inductor, 22 mH	041-113-9-004
L5, 6	Inductor, 150 mH	041-150-9-001
L7	MPX Coil	068-014-9-003
L8	MPX Coil	068-014-9-002
L9, 10	Inductor, 22 mH	041-113-9-004
L11	Inductor, 3.9 mH	041-150-9-002
	MISCELLANEOUS	
X1	Crystal Resonator	135-048-9-001

SCHEMATIC DIAGRAM AND CIRCUIT BOARD MAPS

X71-1000-00 UNIT




X65-1040-00
X71-1000-00
Q1 304KHz
Q2 38KHz
Q3 19KHz
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
OUTPUT ADJ.
19KHz PHASE
METER ADJ.
PRE-EMPHASIS
MODE SELECTOR
LEFT ext. input
RIGHT ext. input
GAIN ADJ.
BALANCE
76KHz TRAP
SEPA. PHASE
LEVEL
LINE VOLT. ADJ.
ANT.
FM OUT (300Ω BALANCED)
OUTPUT
98MHz
85MHz
DEV. ADJ.
FINE ADJ.
117V AC 50/60Hz
230V AC
117V
100V
HOT
NEUTRAL
RED
BLK
WHT
BRN
YEL


power supply
switching circuit
amplifier
VR6 line volt
VR8
VR7
VR4 pre-emph-asis
VR5
VR1
VR2
VR3
meter circuit
osc.
19khz amp.
X1
TC1
VR9

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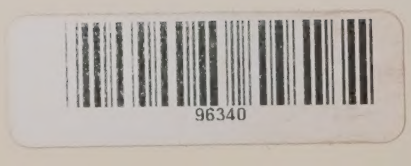
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